Original Communication

Studies of the chronological course of wisdom tooth eruption in a German population

A. Olze PhD DDS (Dentist) [a], C. Peschke DDS (Dentist) [a], R. Schulz MD (Physician) [b], A. Schmeling PhD MD MA (Forensic Physician) [b,*]

[a] *Institute of Legal Medicine, Charité – Universitätsmedizin Berlin, Turmstraße 21, 10559 Berlin, Germany*
[b] *Institute of Legal Medicine, University Hospital Münster, Röntgenstraße 23, 48149 Münster, Germany*

Abstract

Forensic age estimation in living subjects has gained increasing significance in recent years. In dental age estimation, tooth eruption is a parameter of developmental morphology that can be analyzed by either clinical examination or by evaluation of dental X-rays. In the present study, we determined the stage of wisdom tooth eruption in 144 male and 522 female German subjects aged 12–26 years based on radiological evidence from 666 conventional orthopantomograms. The results presented here provide useful data on the age of alveolar, gingival, and complete emergence of the third molars in the occlusal plane that can be utilized for the forensic estimation of the minimum and most probable ages of individuals under investigation.
© 2008 Elsevier Ltd and FFLM. All rights reserved.

1. Introduction

Forensic age assessment of living subjects has become increasingly important over the last few years. The investigated individuals are foreign nationals without valid identification papers whose chronological age is of relevance in legal proceedings. In Germany, the ages of 14, 16, 18 and 21 are of legal relevance.[1] In many other countries, the age of legal majority also ranges from 14 to 18.[2]

The international interdisciplinary Study Group on Forensic Age Diagnostics (http://www.charite.de/rechtsmedizin/agfad/index.htm) recommends that forensic age assessments for determination of criminal responsibility be based on combined clinical, radiological and dental evidence. The clinical examination should include body measurements and an assessment of signs of sexual maturity. An X-ray of the left hand should be used for radiological assessment, and the dental examination should include an assessment of dental status and analysis of an orthopantomogram.[3]

Tooth eruption is a parameter of developmental morphology which, unlike tooth mineralization, can be determined in two ways: by clinical examination and/or by evaluation of dental X-rays. In the cases of teeth 1–7 (according to the FDI World Dental Federation notation), there is sufficient data on the emergence sequences of the permanent dentition to obtain reliable forensic age estimations in children and early adolescents.[4]

In the present study, the chronological course of third molar eruption will be analyzed based on evidence from conventional orthopantomograms obtained in a German population. Based on these findings, the suitability of the age of third molar eruption as a parameter for forensic age estimation in living subjects will be assessed.

2. Materials and methods

A total of 666 conventional orthopantomograms from 144 male and 522 female German subjects from the ages

---

of 12 to 26 were analyzed. The age and sex distribution of the study population is shown in Table 1. The orthopanto-mograms were taken at the Charité Hospital Berlin, Center of Dental Medicine during the years 1988 to 1996. The identification number, sex, date of birth and X-ray examination date of each subject was documented, and the eruption stages of the third molars were determined. The age of each subject was calculated as the date of X-ray minus the date of birth.

The following staging system was used for classification of third molar eruption (Fig. 1):

Stage A: Occlusal plane covered with alveolar bone.
Stage B: Alveolar emergence; complete resorption of alveolar bone over occlusal plane.
Stage C: Gingival emergence; penetration of gingiva by at least one dental cusp.
Stage D: Complete emergence in occlusal plane.

Impacted wisdom teeth were excluded from the analysis. Mesially, distally and vestibulo-orally angulated third molars were classified as impacted as recommended by Archer[5] and Wolf and Haunfelder.[6] Wisdom teeth with an unclear direction of emergence also were not included in the analysis. All staging was carried out by the same observer (A.O.).

Statistical analyses were performed using SPSS software. To cope with outliers and/or skew distributions, differences between groups of interest were analyzed using nonparametric tests (Kruskal–Wallis test for multiple groups, Mann–Whitney U test for two independent groups, and Wilcoxon test for paired observations). Exact versions of the tests were used to handle major differences in sample sizes. The level of significance was defined as $p < 0.05$ (two-sided tables).

3. Results

Tables 2 and 3 show the number of cases, minimum, maximum and mean values with standard deviation ranges, and median values with lower and upper quartiles for the age of eruption of teeth 18, 28, 38 and 48 according to eruption stage for males and females, respectively.

The minimum age of alveolar emergence of the wisdom teeth ranged from 12.0 to 13.2 years in females and from

Table 1
Age and sex distribution of the sample

Age (years)	Male	Female
12	0	13
13	0	28
14	2	33
15	5	48
16	5	45
17	1	49
18	5	41
19	11	51
20	19	39
21	22	60
22	18	31
23	18	42
24	19	33
25	14	9
26	5	0
Total	144	522

Table 2
Statistical data on the age of emergence of teeth 18, 28, 38 and 48, by stage, in males

Tooth	Stage	*n*	Min	Max	Mean	SD	LQ	Median	UQ
18	A	14	14.7	24.9	18.9	3.4	15.5	18.3	21.9
	B	32	14.9	25.7	20.8	2.7	19.7	21.2	22.9
	C	15	18.7	25.8	22.1	2.3	20.1	21.3	24.2
	D	31	19.0	26.9	23.4	2.3	21.9	24.0	25.2
28	A	13	15.0	26.1	18.8	3.3	15.5	18.5	21.0
	B	34	14.7	25.7	21.2	3.0	19.5	21.7	23.3
	C	14	20.0	5.2	21.4	1.5	20.4	20.9	22.4
	D	33	19.2	26.9	23.7	2.2	22.4	24.5	25.4
38	A	6	14.7	22.9	18.6	3.5	15.1	18.3	22.2
	B	17	19.0	26.1	22.4	2.0	20.8	22.5	24.0
	C	30	20.0	26.6	22.8	2.1	21.2	22.3	24.7
	D	27	19.5	26.9	23.6	2.1	22.6	24.0	25.0
48	A	8	14.7	25.2	19.9	4.0	15.7	20.0	23.9
	B	27	14.9	26.6	21.3	2.9	19.9	21.9	22.9
	C	33	18.7	25.8	22.7	1.9	21.4	22.7	24.2
	D	25	19.5	26.9	23.7	2.2	22.1	24.2	25.5

n, number of cases; Min, minimum age; Max, maximum age; SD, standard deviation; LQ, lower quartile; UQ, upper quartile.
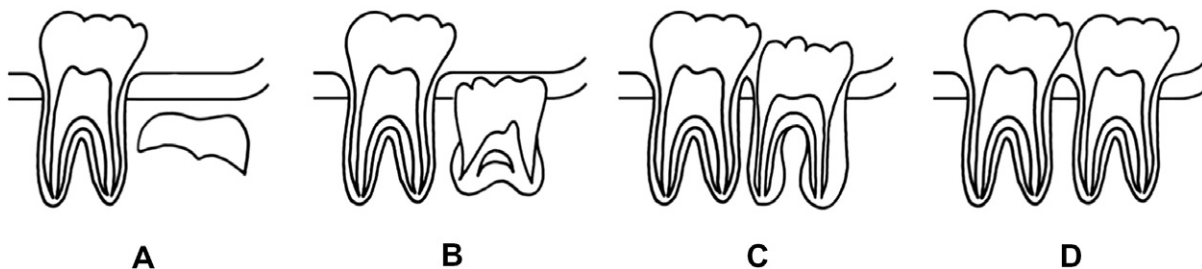

Fig. 1. Stages A–D of third molar eruption.

Table 3
Statistical data on the age of emergence of teeth 18, 28, 38 and 48, by stage, in females

Tooth	Stage	n	Min	Max	Mean	SD	LQ	Median	UQ
18	A	146	12.1	24.4	16.6	3.0	14.1	16.0	18.8
	B	172	12.0	25.4	18.9	3.2	16.3	18.4	21.4
	C	45	16.1	25.2	20.3	2.1	18.8	20.2	21.8
	D	3	23.2	24.7	24.0	0.8	23.2	24.2	24.7
28	A	148	12.1	25.4	16.6	3.1	14.3	16.1	18.5
	B	167	12.0	25.2	18.6	3.0	16.1	18.5	21.0
	C	63	15.6	25.2	20.6	2.7	18.5	20.3	23.3
	D	11	17.9	25.1	22.0	2.1	20.9	22.3	24.0
38	A	105	12.0	21.6	15.5	2.3	13.7	15.2	16.7
	B	104	13.2	25.2	18.9	3.0	16.3	18.7	21.2
	C	99	13.7	25.4	20.2	3.0	17.8	20.2	23.0
	D	16	17.8	25.1	21.9	2.3	20.2	22.2	23.9
48	A	103	12.0	21.6	15.5	2.1	13.8	15.2	16.8
	B	126	12.5	25.2	18.7	3.1	16.1	18.5	21.3
	C	77	13.9	25.4	20.3	2.9	18.0	20.2	23.1
	D	14	17.4	25.8	22.0	2.4	20.2	22.4	23.7

n, number of cases; Min, minimum age; Max, maximum age; SD, standard deviation; LQ, lower quartile; UQ, upper quartile.

14.7 to 19.0 years in males. The mean age of alveolar emergence ranged from 18.6 to 18.9 years in women and from 20.8 to 22.4 years in men. The corresponding standard deviation ranges were 3.0–3.2 years and 2.0–3.0 years, respectively.

The minimum age of gingival emergence was 13.7–16.1 years in females and 18.7–20.0 years in males. The most probable age of gingival emergence was 20.2–20.6 years in women and 21.4–22.8 years in men. The corresponding standard deviation ranges were 2.1–3.0 years and 1.5–2.3 years, respectively.

The minimum age for complete emergence of the wisdom teeth in the occlusal plane was 17.4–23.2 years in women and 19.0–19.5 years in men.

Statistically significant sex differences were observed for tooth 18 at eruption stages A and B, for tooth 28 at stages A, B and D, and for teeth 38 and 48 at all eruption stages. Depending on the tooth, the males were between 1.7 and 4.4 years older than the females at the different eruption stages.

4. Discussion

Studies on the chronology of wisdom tooth eruption are scarce. Rantanen[7] investigated the clinical emergence of third molars in a total of 2218 Finnish males and females ranging in age from 16 to 24 years. The median age of upper and lower wisdom tooth eruption in the male subjects was determined to be 21.7 and 21.8 years, respectively, compared to 23.3 and 23.0 years in females. In this study population, the wisdom teeth of the male subjects emerged roughly 1.5 years earlier than those of the females.

Levesque et al.[8] determined the age of alveolar and gingival emergence and mineralization state of the third molars based evidence from 4640 orthopantomograms from 2278 male and 2362 female Franco-Canadians of ages ranging from 7 to 25 years. Alveolar emergence occurred at a mean age of 17.7 years in the investigated females and 17.2 years in the male subjects. Complete clinical emergence of the wisdom teeth occurred at the age of 19.0 years in the female subjects and 18.5 years in the males. Thus, alveolar emergence of the third molars occurred 0.2 years earlier and gingival emergence occurred 0.5 years earlier in the males than in the females.

Müller[9] analyzed wisdom tooth eruption in 823 male and female German subjects of ages ranging from 16 to 40 years. The median ages of third molar eruption were found to be 20.36 and 20.29 years, respectively. No emergence of third molars was observed in the group of 16-year-olds; the presence of third molars was first detected in the group of 17-year-olds. More than 50% of the third molars had emerged by the age of 21 years.

Due to the different methods our findings can hardly be compared to the findings in the mentioned studies. While the other studies only provide data on the ages of alveolar and gingival emergence of the third molars the present study provides the same information as well as data on the age of emergence of the wisdom teeth in the occlusal plane. Our findings make it possible to estimate the age of investigated persons based on alveolar, gingival and complete emergence of the third molars in the occlusal plane and permit an estimation of the minimum and most probable age of such individuals in the scope of forensic age assessments.

We would like to explain the application of our data in age estimation practice for a female person with tooth 38 showing a stage B. The mean value – and hence the most probable genuine age – identified for this stage is 18.9 years with a standard deviation of 3.0 years. For features that follow a normal distribution, 68% of the persons examined lie within an age interval defined by the mean value ± standard deviation. By approximation, normal distribution may be assumed for the wisdom tooth eruption feature. This means that the genuine age of 68% of all females included in the examination who were assigned a stage B for tooth 38 ranges between 15.9 and 21.9 years. Reducing the margin of error, as would be desirable with a view to forensic age estimation practice, is only possible by combining the assessment of wisdom tooth eruption with other methods as proposed by recommendations of the Study Group on Forensic Age Diagnostics.[3]

References

1. Kaatsch HJ. Juristische Aspekte der Altersschätzung. In: Oehmichen M, Geserick M, editors. *Osteologische Identifikation und Altersschätzung*. Lübeck: Schmidt- Römhild; 2001. p. 243–54.
2. Dünkel F, van Kalmthout A, Schüler-Springorum H, Entwicklungstendenzen und Reformstrategien im Jugendstrafrecht im europäischen Vergleich, Forum, Mönchengladbach; 1997.
3. Schmeling A, Kaatsch H-J, Marré B, Reisinger W, Riepert T, Ritz-Timme S, et al. Empfehlungen für die Altersdiagnostik bei Lebenden im Strafverfahren. *Rechtsmed* 2001;**11**:1–3.
4. Wedl JS, Stiefel BG, Friedrich RE, Dietz K, Schmelzle R. Inspektorische Beurteilung des Durchbruchs der bleibenden Zähne bei Kindern und Jugendlichen als forensisch-odontologisches Hilfsmittel zur Bestimmung des chronologischen Alters. *Rechtsmed* 2002;**12**:87–99.
5. Archer WH: Die Chirurgie des Mundes und der Zähne, Medica, Stuttgart; 1955.
6. Wolf H, Haunfelder D. *Zahnärztliche Mundchirurgie für Studierende der Zahnheilkunde*. Berlin: Berlinische Verlagsanstalt; 1960.
7. Rantanen AV. The age of eruption of the third molar teeth. *Acta Odontol Scand* 1967;**25**(Suppl.):1–86.
8. Levesque GY, Demirjian A, Tanguay R. Sexual dimorphism in the development, emergence, and agenesis of the mandibular third molar. *J Dent Res* 1981;**60**:1735–41.
9. Müller HR: Eine Studie über die Inkonstanz des dritten Molaren (Fehlen, Anlage, Durchbruch). Diss Dresden; 1983.